Basic Electronics

Prepared by:

WD8PUO

The Holland

Amateur Radio Club

A Course for: Technicians and General Class

Voltage – Illustrated as the speed by which water flows through a pipe.

Also referred to as "Electromotive Force", voltage is the splitting off negatively charged electrons being pulled by positively charged nuclei of another atom.

"Higher Voltage" is accomplishing this sharing of electrons more quickly… like higher pressure water in a garden hose.

Unit of Measurement: *Volts (30v. Could be dangerous to humans).*

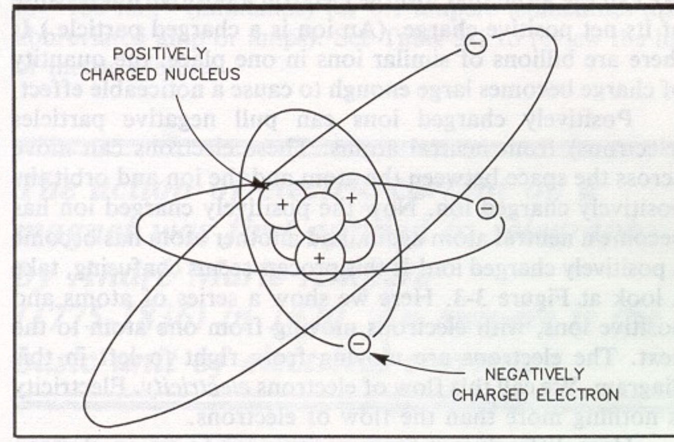


Figure 3-2—Each atom is a microscopic particle composed of a central, dense, positively charged nucleus, surrounded by tiny negatively charged electrons. There are the same number of positive particles in the nucleus and negative electrons outside the nucleus.

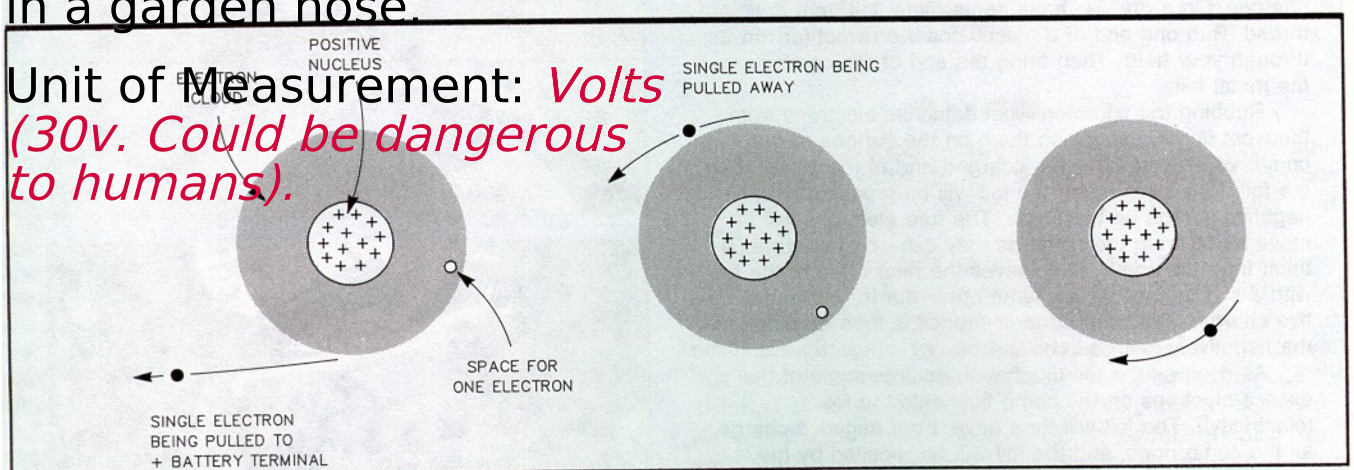


Figure 3-3—An ion is an electrically charged particle. When an electron (a negative ion) moves from one atom to another, the atom losing the electron becomes a positive ion. This electron movement represents an electric current. The electrons are moving from right to left in this drawing.

Basic Electronics

Prepared by:
WD8PU

The Holland Amateur Radio Club

A Course for: Technicians & General Class

<u>Current</u>: Illustrated by the pressure within a garden hose.

The quantity of electrons is comparable to the <u>quantity</u> of water drops required to fill a glass, or a bucket or a tub.

While voltage may give you a “poke”, it is current, the number of electrons that determine if that “poke” will be physically harmful. (Measured by an ammeter).

The Basic unit of measure: *Ampere (1/10th of an ampere could be fatal).*

<u>Power</u>: The measurement of electrical power is called Watts and is determined by (Voltage x Current = Watts).

Example: 120 Volts and .5 Amps can power a 60 Watt light bulb.

Basic Electronics

Prepared by:
WD8PUO

The Holland Amateur Radio Club

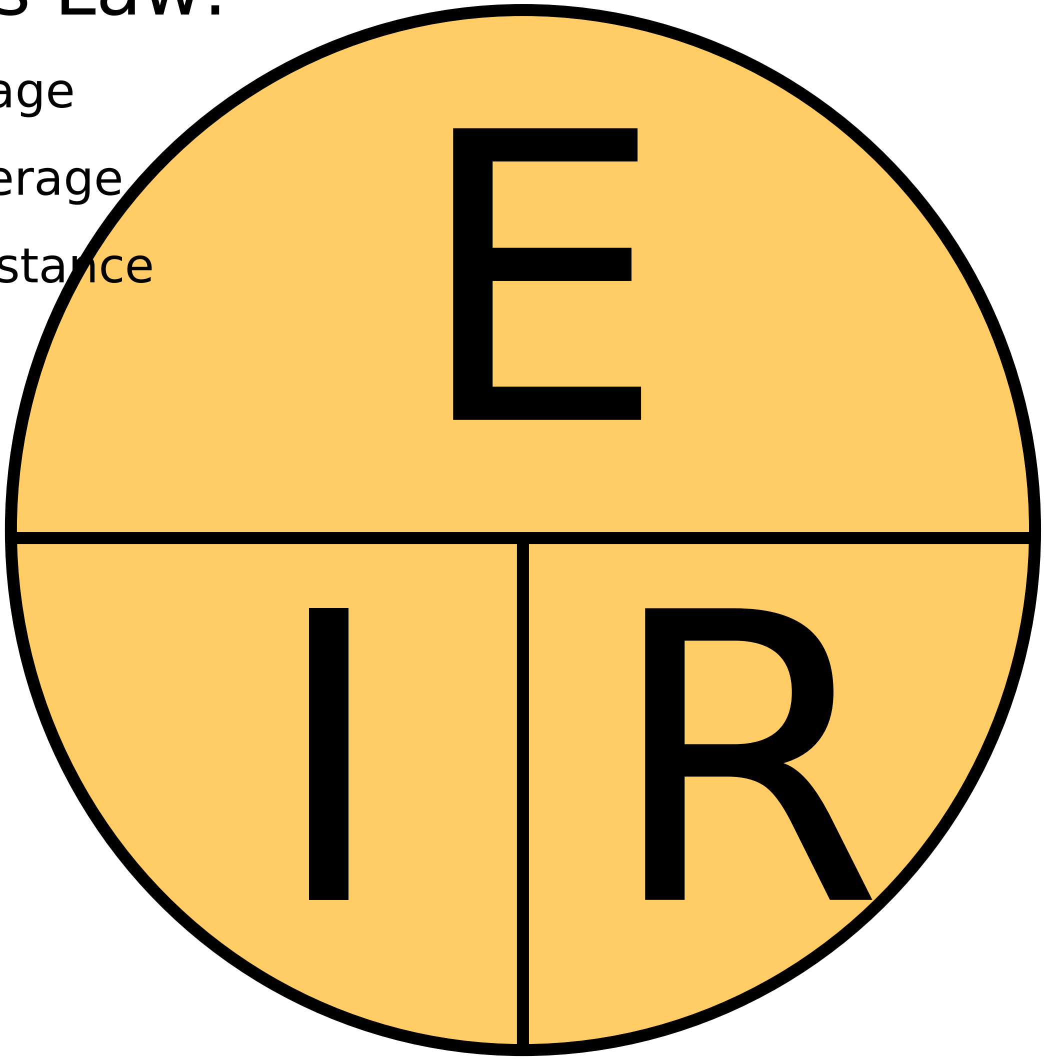
A Course for: Technicians & General Class

Ohm's Law:

E = Voltage

I = Amperage

R = Resistance



E = I x R

I = E/R

R = E/I

*A multi-meter is usually used to measure volts, amperage & ohms.

Basic Electronics

Prepared by:
WD8PUO

The Holland Amateur Radio Club

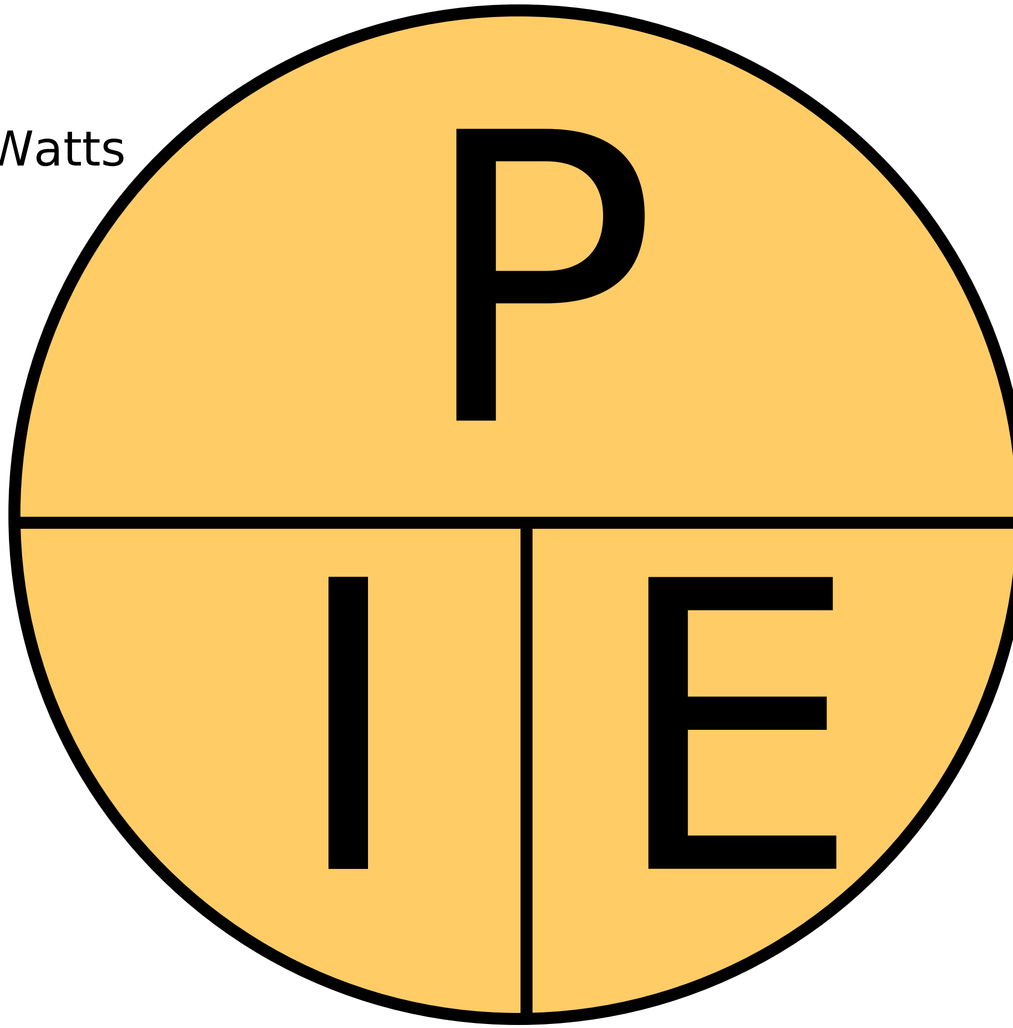
A Course for... Technician & General Class

Ohm's Law for Power:

P = Power in Watts

I = Amperage

E = Voltage



P = I x E

I = P/E

E = P/I

*A watt meter is most accurate at the transmitter output connector.

Basic Electronics

Prepared by:
WD8PU

The Holland Amateur Radio Club

A Course for Technicians & General Class

Series & Parallel Circuits: *Series divides voltage,*

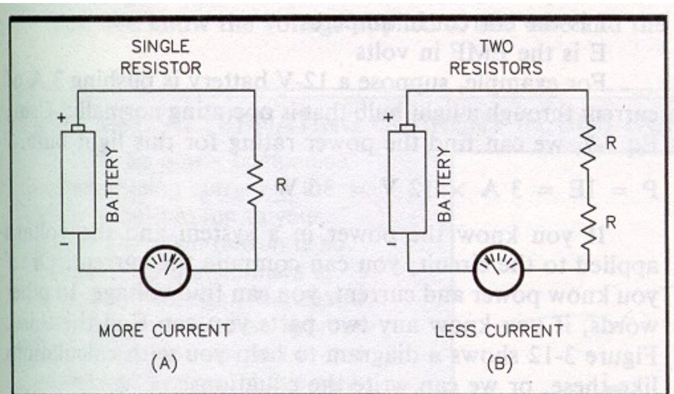


Figure 3-8—Resistance limits the amount of current that can flow in a circuit. Adding a second resistance reduces the current because the total resistance is larger. The total resistance of a string of series-connected resistors is the sum of all the individual resistances.

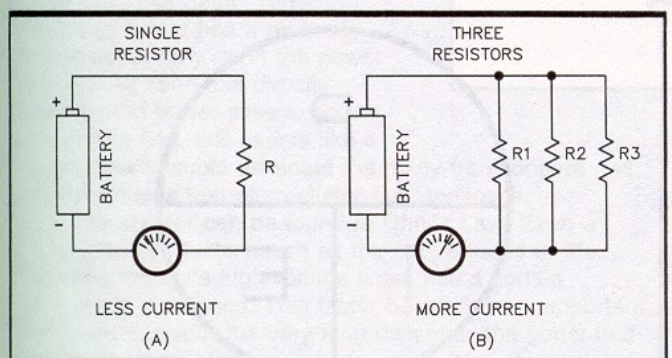


Figure 3-9—Resistors in parallel. In this circuit, the electrical current splits into three separate paths through the resistors. The full battery voltage is applied to each resistor. Current through each individual resistor is independent of the other resistors. For example, if R2 and R3 are changed to a value different than the original value, the current in R1 would remain unchanged. Even if R2 and R3 are removed, the current in R1 remains unchanged.

NOTE: The meter is positioned "in-line" (Series) which is the position to measure current (Amps). The meter would be placed in parallel with the resistance load to measure voltage.

Resistance in series accumulates, example: 10 ohms + 20 ohms = 30 ohms.

Resistance in parallel maintains the same voltage across the various resistors, but the current will be divided according to each individual load.

Basic Electronics

Prepared by:
WD8PUO

The Holland Amateur Radio Club

A Course for: Technician & General Class

Inductance:

The basic unit of measurement: the Henry.

Inductance is often used to store energy in a magnetic field, and also to resist alternating current (AC) while conducting direct current (DC).

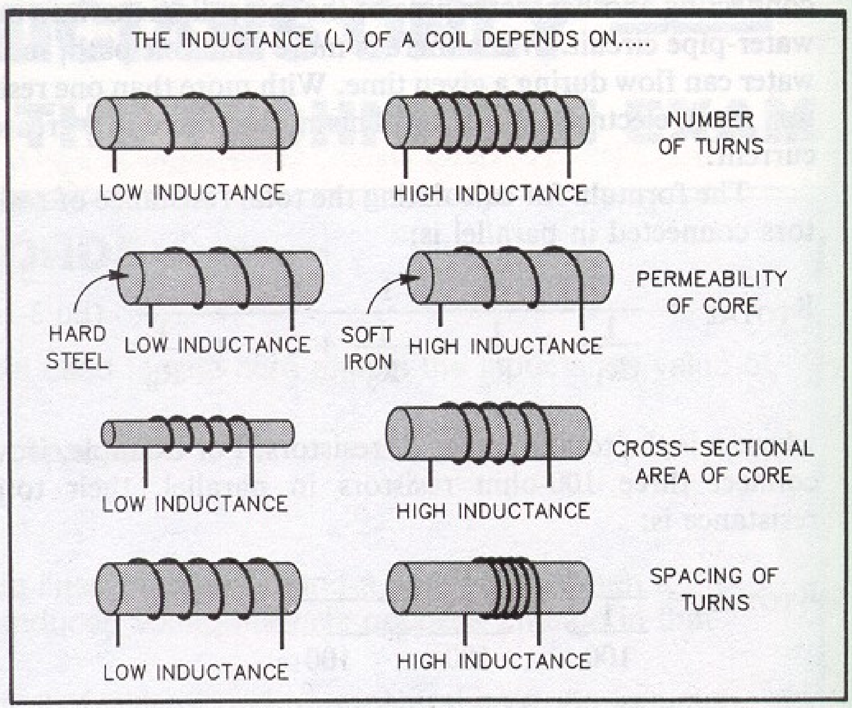


Figure 3-17—The value of an inductor depends on the material used in the core, the number of windings, and the length and diameter of the coil.

Total Inductance In Series =

$L1 + L2 + L3 + L4$, etc.

Total Inductance In Parallel =

$$\frac{1}{\frac{1}{L1} + \frac{1}{L2} + \frac{1}{L3} + \frac{1}{L4} + \frac{1}{L5} + \frac{1}{L6}}$$

For only two parallel-connected inductors...

Basic Electronics

Prepared by:

WD8PUO

The Holland Amateur Radio Club

A Course for... Technicians and General Class

Capacitance:

The basic unit of measure: Farad (uF-microfarad, uuF-picofarad)

The purpose of capacitors is to store energy in an electrical field, and to pass alternating current (AC) but resist direct current (DC).

A capacitor is basically to plates s… ld be

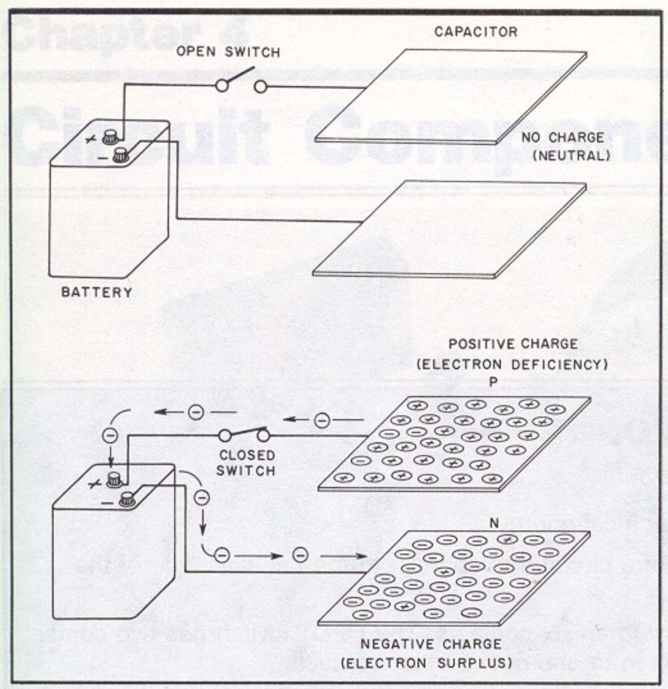


Figure 3-18—When a voltage is applied to a capacitor, an electron surplus (negative charge) builds up on one plate, while an electron deficiency forms on the other plate to produce a positive charge.

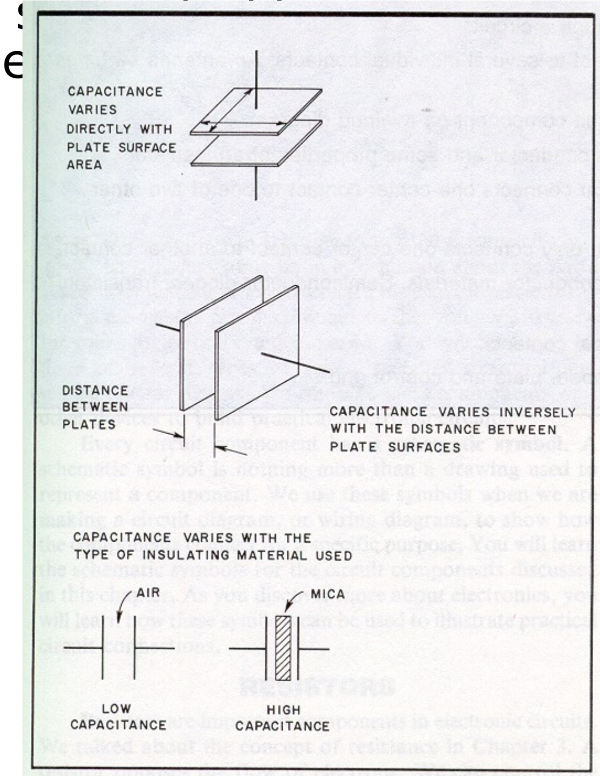


Figure 3-19—The capacitance of a capacitor depends on the area of the plates, the distance between the plates and the type of dielectric material used.

Basic Electronics

Prepared by:

WD8PU C

The Holland Amateur Radio Club

A Course for: Technicians & an General Class

Capacitance:

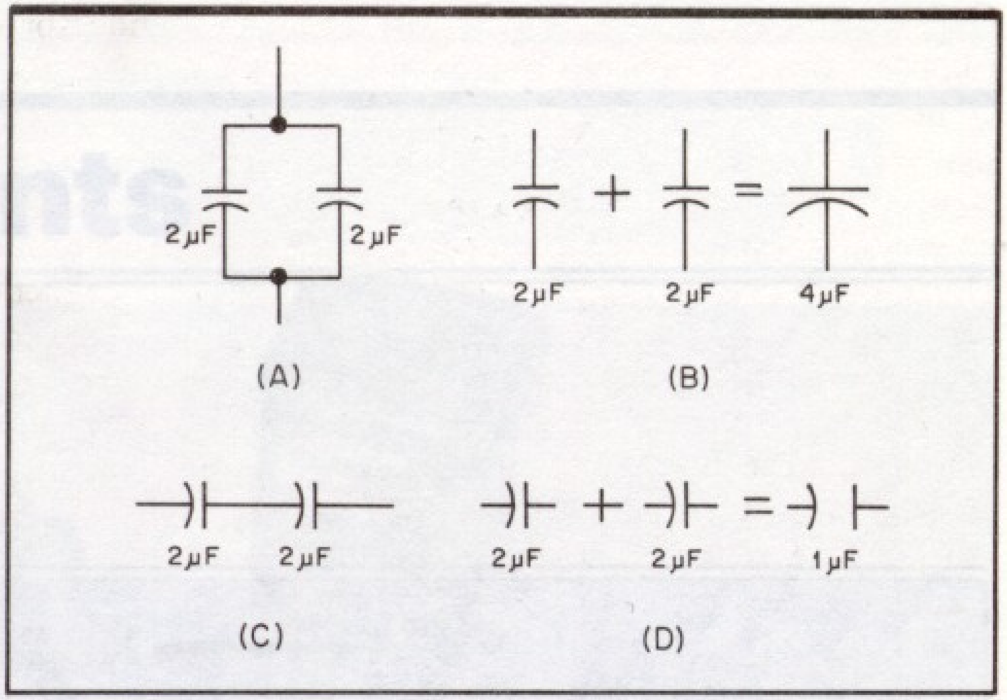


Figure 3-20—Parallel-connected capacitors are shown at A. This connection has the effect of increasing the total plate area, as shown at B. This increases the capacitance. Series connection, shown at C, has the effect of increasing the spacing between the plates, as shown at D. This decreases the capacitance.

Total Capacitance in a Series circuit is actually reduced…

$$\text{Tot.} = \frac{1}{\frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3}}$$

Two capacitors in series…

$$\text{Tot.} = \frac{C1 \times C2}{C1 + C2}$$

Total Capacitance in a parallel circuit is actually increased, because the capacitor plate surface is

NOTE: Capacitors may be non-polarized or polarized. A polarized capacitor is called an "electrolytic capacitor" and will have a (+) or (-) marker. Electrolytic capacitors only

Basic Electronics

Prepared by:

WD8PUO

The Holland Amateur Radio Club

A Course for... Technician & General Class

Reactance:

The basic unit of measurement: Ohms. Ω

Reactance is the property of an inductor or capacitor (Measured in ohms) that impedes current in an alternating current (AC) circuit without converting power to heat.

- Reactance causes the opposition to AC flow in an inductor (coil).
- Reactance causes the opposition to AC flow in a capacitor.
- A coil reacts to AC in that as the frequency of the applied AC increases, the reactance <u>increases</u>.
- A capacitor reacts to Ac in that as the frequency of the applied AC increases, the reactance <u>decreases</u>.

Basic Electronics

Prepared by:

WD8PUO

The Holland Amateur Radio Club

A Course for… Technician & General Class

Impedance:

The basic unit of measure: Ohms Ω

When a circuit contains both resistance and reactance, the combined effect of the two is called “impedance”, symbolized by the letter “Z”.

- Antenna systems are all rated by ohms in impedance.
- Your transmitter output is 50 ohms impedance.
- Your coax feed line is 50 ohms impedance.
- Your transmitter will deliver maximum power output when the impedance load matches the impedance source…this is why impedance matching is so important.

Ham Radio

Basic Electronics

Prepared by:

WD8PUO

The Holland Amateur Radio Club

A Course for...: Technician & General Class

End of Lesson 5